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TOTAL TREE WEIGHT TABLES FOR MOCKERNUT HICKORY AND WHITE ASH IN NORTH GEORGIA

BY

ALEXANDER CLARK III AND W. HENRY McNAB

RESEARCH DIVISION

GEORGIA FORESTRY COMMISSION

AUTHORS

Alexander Clark III is a Wood Scientist with the Southeastern Forest Experiment Station at Athens, Georgia. He received a B.S. degree in Forestry and M.S. degree in Wood Technology from West Virginia University. He is a member of the Utilization of Southern Timber Research Work Unit.

W. Henry McNab is Silviculturist with the Southeastern Forest Experiment Station at Athens, Georgia. He has a B.S. degree in Forest Management and M.S. in Silviculture, both from the University of Florida. He is a member of the Utilization of Southern Timber Research Work unit, where he works mainly on problems related to the effects of silvicultural practices on biomass yields and utilization of forest residues.

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INTRODUCTION

Poor quality hardwoods are now being harvested for firewood or total-tree chipped for fuel while better quality trees produce saw logs and pulpwood. In either case, most of these products are bought and sold by weight. Tables for estimating the weight of hardwood trees and their components are needed to assist in the equitable marketing of fuel chips, firewood, and conventional forest products.

This paper presents green wood and bark weights for commercial-size mockernut hickory (Carya tomentosa (Poir.) Nutt) and white ash (Fraxinus americana L.) growing in mixed hardwood stands in North Georgia. Tables show the weight of the total tree, saw-log merchantable stem, and stem to 4-inch top for trees 5 to 22 inches d.b.h.

Figure 1. --Researchers weighing upper stemwood and branches on portable field scales.

PROCEDURE

A total of 27 mockernut hickory trees 5 to 20 inches d.b.h. and 31 white ash trees 5 to 18 inches d.b.h. were sampled in the Chattahoochee National Forest in Union and Lumpkin Counties in North Georgia. A stratified random sample of two to seven trees per 2-inch d.b.h class was selected for each species from natural, uneven-aged, mixed hardwood stands. The mockernut hickory trees ranged from 26 to 160 years old and averaged 95 years. The white ash trees ranged from 35 to 180 years old and averaged 66 years. For sawtimber-size trees (11.0 inches d.b.h. and larger) mockernut hickory had an average form class of 80 and white ash averaged 77. Means and ranges in dimensions of sample trees are shown in Table 1 for each species.

Trees were felled and limbed during the winter, and the main stem of each sawtimber tree was bucked into merchantable saw logs 8 to 16 feet long to a 9-inch d.o.b. top, or where a Forest Service grade 3 log stopped. Stem d.o.b. at the saw-log top averaged 11.4 inches in the mockernut hickories and 11.2 inches in the white ash (Table 1). All material between the saw-log merchantable top and the 4-inch d.o.b. top was classified as stem pulpwood. In pulpwood-size trees (5.0 to 10.9 inches d.b.h.), the main stem was bucked at a 4-inch d.o.b. top. The stem material above the 4-inch top and all branches was considered crown. The crowns of the sample trees were cut up in two categories: (1) branches 4-inches d.o.b. and larger and (2) branches less than 4-inches d.o.b., and weighed. Upper stem and crown material were weighed by hand to the nearest pound using portable scales (Figure 1). Saw logs were skidded to a landing and weighed individually on an electronic scale (Figure 2).

WEIGHT TABLES

A series of equations were developed based on the sample tree weights to predict weights of total trees and their components. Because tree heights are measured to different top limits by various organizations, equations were developed by using d.b.h. and height to 4-inch top and d.b.h. and saw-log merchantable height. The equations were used to develop tables of total tree and component weights in pounds. Tables 2-4 show predicted green weights of wood and bark in the total tree above stump, saw-log merchantable stem, and stem to 4-inch d.o.b. top by d.b.h. and saw-log merchantable height classes. Tables 5-7 show total tree and tree component weights by d.b.h. and height to 4-inch top. Crown weight excluding foliage can be estimated by subtracting predicted stem weight to 4-inch top from predicted total tree weight.

All tables are good predictors of tree weights, but tables based on d.b.h. and height to 4-inch top are the best predictors of total tree and stem to a 4-inch top weight. Tables based on d.b.h. and saw-log merchantable height are the best estimators of saw-log merchantable stem.

Similar-size trees may vary in weight because of differences in crown size and stem taper. Therefore, the weight tables presented should be applied to trees growing in fully stocked, natural stands and not to open-grown trees.

Figure 2. --Hardwood saw logs being weighed on portable electronic scale.

Table 1.--Means and ranges in dimensions of mockernut hickory and white ash sampled in north Georgia

D.b.h. class (inches)	Sample trees	D.b.h.		Total height		Height to 4-inch d.o.b. top		Height to saw-log merchantable top[1/]		D.o.b. at saw-log merchantable top	
		Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
	Number	*Inches*		*Feet*						*Inches*	
					HICKORY						
6	3	6.1	5.1- 6.8	56	48-61	27	20-32	-	-	-	-
8	4	7.8	7.0-8.5	67	58-80	43	35-54	-	-	-	-
10	4	10.0	9.4-10.9	78	70-85	56	50-65	-	-	-	-
12	3	11.7	11.7-11.8	83	72-88	66	53-73	28	17-34	9.4	9.1-9.7
14	4	13.9	13.0-14.9	86	77-92	66	57-76	35	34-38	10.8	10.0-12.4
16	3	16.4	16.0-16.8	97	92-105	76	66-84	48	46-50	11.5	10.8-12.1
18	4	17.6	17.1-18.1	101	97-108	85	78-91	53	49-59	12.7	11.0-14.3
20	2	19.3	19.1-19.4	102	100-103	87	86-87	52	50-56	13.0	12.5-13.4
All classes	27	12.5	5.1-19.4	83	48-108	62	20-91	43	17-59	11.4	9.1-14.3
					ASH						
6	6	6.0	5.0-6.7	61	44-74	33	15-42	-	-	-	-
8	4	7.9	7.0-8.9	59	52-64	38	31-46	-	-	-	-
10	8	9.6	9.0-10.2	74	66-84	54	46-67	-	-	-	-
12	3	12.0	11.0-12.9	81	77-85	61	55-66	28	24-33	9.7	9.0-11.1
14	5	13.8	13.1-14.7	87	73-97	67	52-80	33	17-45	11.4	10.5-12.6
16	3	16.2	15.7-16.6	105	85-119	87	66-103	50	34-73	11.3	9.7-13.0
18	2	18.4	18.1-18.6	101	97-104	86	85-88	53	48-57	13.1	12.3-13.9
All classes	31	10.8	5.0-18.6	77	44-119	56	15-103	37	17-73	11.2	9.0-13.9

[1/] Height to 9-inch d.o.b. or saw-log merchantable top

Table 2.--Predicted green weight of wood and bark in the total tree above stump for mockernut hickory and white ash by d.b.h. and saw-log merchantable height[1/]

D.b.h. (inches)	Merchantable height (logs)[2/]								
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
	Pounds								
	HICKORY[3/]								
11	1845	2023	2160	2273	2370				
12	2200	2411	2575	2710	2825				
13	2586	2835	3027	3185	3321	3441			
14	3004	3293	3516	3700	3858	3997			
15	3454	3785	4042	4254	4435	4595	4738		
16		4313	4605	4846	5053	5235	5398		
17		4875	5205	5478	5712	5917	6102	6270	
18		5472	5842	6148	6411	6642	6849	7037	
19		6103	6517	6858	7151	7409	7640	7850	8043
20		6770	7228	7607	7932	8218	8474	8707	8921
21		7471	7977	8395	8754	9069	9352	9609	9845
22		8208	8764	9223	9616	9963	10274	10556	10816
	ASH[4/]								
11	1272	1443	1579	1694	1795				
12	1460	1656	1813	1945	2060				
13	1657	1880	2058	2208	2339	2456	2562	2660	2750
14	1864	2115	2315	2483	2631	2762	2881	2991	3093
15	2079	2359	2582	2770	2934	3081	3214	3337	3450
16	2303	2613	2860	3069	3251	3413	3561	3696	3822
17		2877	3149	3378	3578	3757	3920	4069	4208
18		3149	3447	3698	3918	4114	4292	4455	4607
19		3431	3756	4029	4268	4482	4676	4854	5019
20		3722	4074	4371	4630	4861	5072	5265	5444
21		4021	4401	4722	5002	5252	5479	5688	5881
22		4329	4738	5083	5385	5654	5899	6123	6332

[1/] Blocked-in area indicates range of data

[2/] Includes 0.5-foot stump allowance

[3/] $Y = 7.54384(D^2)^{1.01035}(Mh)^{0.23191}$

[4/] $Y = 11.53722(D^2)^{0.79252}(Mh)^{0.31958}$

Table 3.--Predicted green weight of wood and bark in the saw-log merchantable stem for mockernut hickory and white ash by d.b.h. and saw-log merchantable height[1/]

D.b.h. (inches)	Merchantable height (logs)[2/]								
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
	Pounds								
	HICKORY[3/]								
11	601	850	1089	1320	1546				
12	702	993	1272	1543	1807				
13	811	1147	1469	1782	2087	2385			
14	926	1310	1678	2035	2383	2725			
15	1048	1482	1899	2303	2697	3084	3463		
16		1664	2132	2586	3029	3462	3889		
17		1856	2377	2883	3377	3860	4335	4803	
18		2056	2634	3195	3741	4277	4804	5322	
19		2266	2902	3520	4123	4713	5293	5864	6428
20		2484	3182	3859	4520	5167	5803	6430	7048
21		2711	3473	4213	4934	5640	6334	7018	7692
22		2947	3776	4579	5363	6131	6886	7629	8362
	ASH[4/]								
11	453	642	823	998	1170				
12	526	744	954	1158	1357				
13	603	853	1094	1327	1555	1778	1997	2213	2427
14	684	968	1241	1506	1764	2017	2266	2511	2753
15	769	1089	1396	1693	1984	2269	2549	2824	3096
16	859	1215	1558	1890	2214	2532	2845	3153	3456
17		1347	1727	2096	2455	2808	3154	3496	3832
18		1485	1904	2310	2706	3095	3477	3853	4224
19		1629	2088	2533	2968	3394	3812	4225	4632
20		1777	2278	2764	3239	3703	4160	4611	5055
21		1931	2476	3004	3519	4024	4521	5010	5493
22		2090	2680	3251	3809	4356	4894	5423	5946

[1/] Blocked-in area indicates range of data

[2/] Includes 0.5-foot stump allowance

[3/] $Y = 0.68566(D^2)^{0.89721}(Mh)^{0.87644}$

[4/] $Y = 0.63993(D^2)^{0.85174}(Mh)^{0.87850}$

Table 4.--Predicted green weight of wood and bark in the stem to a 4-inch d.o.b. top for mockernut hickory and white ash by d.b.h. and saw-log merchantable height[1/]

D.b.h. (inches)	Merchantable height (logs)[2/]								
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
	Pounds								
	HICKORY[3/]								
11	1292	1542	1749	1929	2091				
12	1496	1785	2025	2233	2420				
13	1712	2042	2317	2556	2770	2965			
14	1940	2314	2624	2895	3138	3359			
15	2178	2599	2948	3252	3524	3772	4002		
16		2897	3286	3625	3928	4205	4461		
17		3208	3639	4014	4351	4657	4940	5205	
18		3532	4007	4420	4790	5127	5439	5731	
19		3869	4388	4841	5246	5616	5958	6277	6577
20		4218	4784	5278	5720	6123	6495	6843	7170
21		4579	5194	5729	6209	6647	7051	7429	7784
22		4952	5617	6196	6715	7188	7625	8034	8418
	ASH[4/]								
11	862	1039	1188	1318	1436				
12	1002	1208	1381	1532	1668				
13	1150	1387	1585	1759	1916	2059	2192	2317	2435
14	1307	1576	1801	1999	2177	2340	2491	2633	2767
15	1472	1775	2029	2252	2452	2636	2807	2966	3117
16	1646	1984	2268	2517	2741	2947	3137	3316	3484
17		2203	2519	2795	3044	3272	3483	3681	3868
18		2432	2780	3085	3359	3611	3845	4063	4269
19		2670	3052	3387	3688	3964	4221	4461	4687
20		2917	3334	3700	4029	4331	4611	4874	5121
21		3173	3627	4025	4383	4712	5016	5302	5571
22		3438	3930	4362	4750	5106	5436	5745	6037

[1/] Blocked-in area indicates range of data

[2/] Includes 0.5-foot stump allowance

[3/] $Y = 6.48403(D^2)^{0.84171}(Mh)^{0.44596}$

[4/] $Y = 3.61719(D^2)^{0.86305}(Mh)^{0.47302}$

Table 5.--Predicted green weight of wood and bark in the total tree above stump for mockernut hickory and white ash by d.b.h. and height to a 4-inch d.o.b. top[1/]

D.b.h. (inches)	Height to 4-inch top (feet)[2/]								
	20	30	40	50	60	70	80	90	100
	Pounds								
	HICKORY[3/]								
5	167	242	315	387					
6	233	338	440	540					
7	309	448	583	716	846	974			
8	395	573	745	914	1080	1243			
9		710	924	1134	1340	1543	1743		
10		861	1121	1375	1625	1871	2114		
11			1335	1637	1934	2227	2517	2803	
12			1565	1920	2268	2612	2952	3288	
13			1812	2223	2626	3024	3417	3806	4192
14			2075	2546	3008	3464	3914	4359	4801
15			2355	2888	3413	3930	4441	4946	5447
16			2650	3250	3841	4423	4998	5566	6130
17			2961	3632	4291	4942	5584	6220	6849
18			3288	4032	4765	5487	6200	6906	7605
19			3630	4452	5260	6058	6845	7624	8396
20			3987	4890	5778	6654	7519	8375	9223
21			4359	5347	6318	7275	8221	9157	10084
22			4747	5822	6880	7922	8952	9971	10981
	ASH[4/]								
5	186	252	314	371					
6	245	332	413	489					
7	309	420	522	618	710	798			
8	378	514	639	757	869	976			
9		614	764	905	1038	1167	1291	1412	
10		721	896	1061	1218	1369	1515	1656	
11			1035	1226	1407	1581	1750	1913	2072
12			1181	1398	1605	1804	1996	2182	2364
13			1333	1579	1812	2037	2253	2464	2668
14			1492	1766	2028	2279	2521	2756	2985
15			1656	1961	2251	2530	2799	3060	3314
16			1826	2162	2482	2789	3086	3374	3654
17			2001	2370	2721	3058	3383	3699	4006
18			2182	2584	2967	3334	3689	4033	4368
19			2369	2805	3220	3619	4004	4377	4741
20			2560	3031	3480	3911	4327	4731	5124
21			2756	3264	3747	4211	4659	5094	5517
22			2958	3502	4020	4518	4999	5465	5919

[1/] Blocked-in area indicates range of data

[2/] Includes 0.5-foot stump allowance

[3/] $Y = 0.56588(D^2H4)^{0.91527}$

[4/] $Y = 1.67770(D^2H4)^{0.75724}$

Table 6.--Predicted green weight of wood and bark in the saw-log merchantable stem for mockernut hickory and white ash by d.b.h. and height to 4-inch d.o.b. top[1/]

D.b.h. (inches)	Height to 4-inch top (feet)[2/]						
	40	50	60	70	80	90	100
	Pounds						
	HICKORY[3/]						
11	553	715	882	1053	1228	1406	
12	675	873	1077	1286	1500	1718	
13	812	1050	1295	1547	1804	2066	2332
14	963	1245	1536	1835	2139	2450	2766
15	1129	1460	1801	2150	2508	2872	3242
16	1310	1694	2089	2495	2910	3332	3762
17	1506	1947	2402	2869	3345	3831	4325
18	1718	2221	2740	3272	3816	4370	4934
19	1946	2516	3103	3706	4322	4950	5588
20	2190	2831	3492	4171	4864	5570	6288
21	2450	3168	3908	4667	5442	6232	7036
22	2727	3526	4350	5194	6057	6937	7832
	ASH[4/]						
11	440	556	674	792	911	1030	
12	528	668	808	950	1093	1237	1381
13	625	790	956	1124	1293	1463	1633
14	730	923	1117	1313	1510	1708	1908
15	844	1066	1291	1517	1745	1974	2205
16	966	1221	1478	1737	1998	2260	2524
17	1097	1386	1678	1972	2269	2567	2866
18	1237	1562	1892	2223	2557	2893	3231
19	1385	1750	2119	2490	2864	3241	3619
20	1542	1949	2359	2773	3190	3609	4030
21	1708	2159	2613	3072	3533	3997	4464
22	1883	2380	2881	3386	3895	4407	4922

[1/] Blocked-in area indicates range of data

[2/] Includes 0.5-foot stump allowance

[3/] $Y = 0.03164(D^2H4)^{1.15129}$

[4/] $Y = 0.06038(D^2H4)^{1.04832}$

Table 7.--Predicted green weight of wood and bark in the stem to a 4-inch d.o.b. top for mockernut hickory and white ash by d.b.h. and height to a 4-inch d.o.b. top[1/]

D.b.h. (inches)	Height to 4-inch top (feet)[2/]								
	20	30	40	50	60	70	80	90	100
	Pounds								
	HICKORY[3/]								
5	116	170	223	275					
6	163	240	315	388					
7	219	321	421	520	618	715			
8	281	413	542	669	795	920			
9		516	677	836	993	1149	1304		
10		630	826	1020	1212	1402	1591		
11			989	1222	1452	1679	1905	2130	
12			1166	1440	1711	1980	2246	2510	
13			1357	1676	1991	2303	2613	2920	3226
14			1561	1928	2290	2649	3006	3360	3711
15			1778	2196	2609	3018	3424	3828	4229
16			2009	2481	2948	3410	3869	4324	4777
17			2253	2782	3306	3824	4339	4849	5357
18			2510	3100	3683	4260	4834	5403	5969
19			2781	3433	4079	4719	5354	5984	6611
20			3064	3783	4494	5199	5899	6594	7284
21			3360	4149	4929	5702	6469	7231	7988
22			3668	4530	5382	6226	7064	7895	8722
	ASH[4/]								
5	117	164	208	251					
6	158	222	282	340					
7	204	287	365	440	512	582			
8	256	359	456	550	640	728			
9		437	555	669	779	886	991	1093	
10		521	662	798	929	1057	1181	1304	
11			776	936	1089	1239	1385	1529	1669
12			898	1082	1260	1433	1602	1768	1931
13			1026	1237	1440	1638	1831	2021	2207
14			1162	1400	1630	1854	2073	2287	2498
15			1304	1571	1829	2081	2326	2567	2803
16			1452	1750	2038	2318	2591	2859	3122
17			1607	1936	2255	2565	2867	3164	3455
18			1768	2130	2481	2822	3155	3481	3801
19			1935	2332	2715	3088	3453	3810	4160
20			2108	2540	2958	3365	3762	4151	4533
21			2287	2756	3209	3651	4081	4503	4918
22			2472	2979	3469	3946	4411	4867	5315

[1/] Blocked-in area indicates range of data

[2/] Includes 0.5-foot stump allowance

[3/] $Y = 0.32540\ (D^2H4)^{0.94522}$

[4/] $Y = 0.64813\ (D^2H4)^{0.83543}$

A. Ray Shirley, Director
John W. Mixon, Chief of Forest Research